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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/596,022	05/25/2006	Toshiharu Furukawa	FIS920030339US1	1812
32074 7590 10/19/2009 INTERNATIONAL BUSINESS MACHINES CORPORATION DEPT. 18G BLDG. 321-482 2070 ROUTE 52 HOPEWELL JUNCTION, NY 12533				
EXAMINER GEBREYESUS, YOSEF				
ART UNIT		PAPER NUMBER		
2811				
NOTIFICATION DATE		DELIVERY MODE		
10/19/2009		ELECTRONIC		

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

EFIPLAW@US.IBM.COM

# Office Action Summary

**Application No.**

10/596,022

**Applicant(s)**

FURUKAWA ET AL.

**Examiner**

YOSEF GEBREYESUS

**Art Unit**

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 25 June 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 May 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-8508)
- Paper No(s)/Mail Date \_\_\_\_\_

- 4) ☐ Interview Summary (PTO-413)
- Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Information Disclosure Statement***

1. The information disclosure statement (IDS) submitted on 5/25/2006 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner. If the Applicant is aware of any prior art or co-pending applications not already in record Applicant is reminded the duty to disclose under 37 C.F.R. 156.

### ***Specification***

2. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

### ***Claim Rejections - 35 USC § 102***

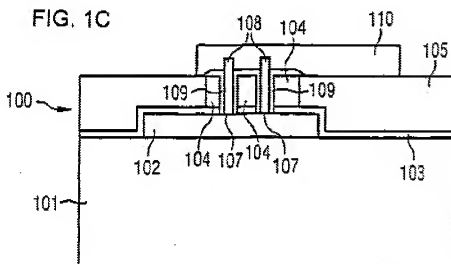
3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-7 and 10 are rejected under 35 U.S.C. 102(e) as being anticipated by Roesner et al. (US 2003/0132461, dated July 17<sup>th</sup>, 2003, filed January 28<sup>th</sup>, 2003).

5. Regarding **claim 1**, figures 1A- 1C of Roesner et al. discloses a substrate (layer) 105 (paragraph [0062]); at least one trench in said substrate 105; conductive carbon nanotubes 108 (paragraph [0071]) lining said trench; and a trench conductor 104 (gate layer) (paragraph [0061]) filling said trench, wherein said trench conductor 104 and said substrate 105 having a co-planar top surface.



6. Regarding **claim 2**, figures 1A-1C of Roesner et al. discloses a substrate 105; at least one trench in said substrate 105; conductive carbon nanotubes 108 lining said trench; a trench conductor 104 filling said trench; and a trench dielectric (dialuminum trioxide) 103 and 109 (paragraph [0058] and [0074]) between said carbon nanotubes 108 and sidewalls of said trench.

7. Regarding **claim 3**, figures 1A-1C of Roesner et al. discloses a layer of trench dielectric (dialuminum trioxide) 103 and 109 (paragraph [0058] & [0074]) on top of a bottom of said trench and between said carbon nanotubes 108 and sidewalls of said

trench, wherein the conductive carbon nanotubes 108 form an open cylinder structure lining said sidewalls of said trench through said layer of trench dielectric 103 & 109.

8. Regarding **claim 4**, figures 1A-1C of Roesner et al. discloses wherein the trench conductor 104 comprises a metal (paragraph [0074]), said layer of trench dielectric 103 & 109 on top of said bottom of said trench.

9. Regarding **claim 5**, figures 1A-1C of Roesner et al. discloses wherein characterized in that the conductive carbon nanotubes 108 and the trench conductor 104 are disposed in the trench, and the trench conductor is carbon free (titanium) (paragraph [0061]).

10. Regarding **claim 6**, figures 1A-1C of Roesner et al. discloses characterized in that the substrate 105 is free of carbon nanotube catalyst materials 107 (the substrate is dialuminum trioxide and the catalyst materials are nickel, cobalt or iron) (paragraph [0033] and [0058]).

11. Regarding **claim 7**, figures 1A-1C of Roesner et al. discloses characterized in that the carbon nanotubes 108 form a consistent lining along approximately the entire length of sidewalls of said trench (shown in figure 1C).

12. Regarding **claim 10**, figures 1A-1C of Roesner et al. discloses further comprising a trench dielectric 103 & 109 between said carbon nanotubes 108 and sidewalls of said trench.

***Claim Rejections - 35 USC § 103***

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

15. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Roesner et al. as applied to claim 2 above.

16. Regarding claim 8, figures 1A-1C of Roesner et al. discloses characterized in that the trench-type device is planarized so that a top surface of the substrate 105 is coplanar with respective top surface the trench conductor 104.

Roesner et al. does not disclose the top surface of the substrate is coplanar with respective top surfaces of the trench dielectric, the conductive carbon nanotubes.

However, it would have been obvious to one ordinary skill in the art at the time of invention to modify Roesner et al.'s device by forming the substrate 105 coplanar with respect top surface of the trench dielectric 109, the conductive carbon nanotubes 108

for the purpose of making small size stackable devices and to minimize manufacturing cost.

17. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Roesner et al. in view of Yoshikazu Homma ("Growth of suspended carbon nanotube..." dated 09/16/2002, hereinafter Homma et al.) as applied to claim 1 above.

18. Regarding **claim 9**, figures 1A-1C of Roesner et al. substantially discloses the claimed invention except the conductive nanotubes are grown downwards into the trench.

However, in the same field of endeavor Homma et al. discloses growing nanotubes downward (page 2263, 5<sup>th</sup> paragraph).

Therefore, it would have been obvious to one ordinary skill in the art at the time of invention to form the carbon nanotubes of Hsu et al.'s device by growing downwards as taught by Homma et al. for the purpose of forming vertical nanotubes without arches at the top (page 2263 col. 2 lines 15-19).

### ***Response to Arguments***

19. Applicant's amendment filed on 6/25/2009 overcame the objection to the drawings, the objection to the specification, the objection to claim 8 and the 35 U.S.C. 112, 2<sup>nd</sup> rejection to claims 5 and 8. The objection to the drawings, the objection to the specification, the objection to claim 8 and the 35 U.S.C 112, 2<sup>nd</sup>, rejection to claims 5 and 8 have been withdrawn.

20. Therefore, claims 1-5 and 8 as amended by the amendment, claims 6-7 and 9 as previously recited are currently in the application, presently newly added claim 10.

21. Applicant's arguments with respect to claims 1-9 have been considered but are moot in view of the new ground(s) of rejection.

22. The examiner would like to emphasize the new ground(s) of rejection is established because Applicant has added new limitation "wherein said trench conductor and said substrate having a co-planar top surfaces" in claim 1; "further comprising a layer of trench dielectric on top of a bottom of said trench and between said carbon nanotubes and sidewalls of said trench" on claim 3; and "contacting said layer of trench dielectric on top of said bottom of said trench" in claim 4. The examiner is required to use the broadest reasonable interpretation to examiner the amended claims (MPEP 2111). The detail examination is listed in this office action.

### ***Conclusion***

23. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not



mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to YOSEF GEBREYESUS whose telephone number is (571)270-5765. The examiner can normally be reached on Monday through Thursday 7:30 to 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne A. Gurley can be reached on 571-272-1670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Lynne A. Gurley/  
Supervisory Patent Examiner, Art  
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Yosef Gebreyesus  
10/01/2009

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